

Arthropod Fauna of the nests of some common birds in Poona, India, with special reference to blood sucking forms

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A study of the arthropod fauna of the nests of six common birds of Poona was made. The number of nests examined were : 56 *Corvus splendens*, 35 *Ploceus philippinus*, 14 *Acridotheres tristis*, 4 *Passer domesticus*, 4 *Hirundo concolor* and one *Copsychus saularis*. All the arthropods collected were classified and the frequency of their occurrence and number collected were recorded. The blood sucking forms received special attention. Those collected were: *Mites*:—*Ornithonyssus bursa*, and a new species of *Pellonyssus* of the family Dermanyssidae and two species of *Laelaps* of the family Laelaptidae; *Ticks*:—one species each of *Haemaphysalis* and *Argas*; *Diptera*:—Four species of *Culicoides* and one species of Sandfly (*Sergentomyia*); one louse and two species of anthocorid bugs.

The factors governing the association of these blood sucking forms and the avian hosts are discussed. Mites were the most abundant among the arthropods collected. While crow nests harboured both the common species, viz. *O. bursa* and *Pellonyssus*, weaverbird nests did not, except for a solitary specimen, have *Ornithonyssus*.

INTRODUCTION

It is well known that nests of birds harbour a rich and varied arthropod fauna. Though naturalists including those in India, have often been attracted by them there have been till recently few studies exclusively devoted to them. Most of the observations of the fauna of bird nests have been stray ones made in connection with the habits of the birds concerned. Woodroffe (1953) made an outstanding contribution to the subject by his study of the insects and mites in the nests of some birds in Great Britain and by presenting a useful bibliography. He has also critically reviewed the important work of Nordberg (1936) in Finland, which had been completely overlooked by other workers. A brief but very informative review has also been made by Rothschild & Clay (1952).

While nests of birds offer to the zoologist an interesting ecological niche to study the inter-relationships between birds, their ectoparasites

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and other nest-inhabiting fauna, they provide the medical research workers with a convenient place to look into for the probable arthropod vectors of diseases of man and animals, particularly of those diseases in the epidemiology of which birds have a role. The observations recorded in this paper were made in the course of a wider study of the ectoparasites of birds in connection with virological investigations in India.

The main objective of these studies was to determine the blood sucking arthropods associated with birds and their fledglings within their nests. While the other arthropods collected were also enumerated and preserved there was neither time nor immediate necessity to embark upon a detailed taxonomic study of all the forms. It has however been possible to sort out the fauna at least up to orders but in the case of blood sucking forms the identifications have been made up to species wherever possible. As it is believed that this is the first systematic study of its kind on the nests of Indian birds the data collected are deemed worthy of presentation though they may fall short of the requirements of a thorough ecological investigation. The work was done mainly during the year 1953 and has hitherto remained unrecorded. Subsequently nests of several species have been examined from time to time and the findings of the previous study generally confirmed.

The authors gratefully acknowledge the help given by Mr. B. S. Lamba in the collection of the nests and their transportation to the laboratory. Dr. J. A. Kerr, the then Director, and Dr. Harold N. Johnson the then Virologist at this Centre made many useful suggestions for which thanks are due to them.

MATERIALS AND METHODS

The material consisted of 56 nests of *Corvus splendens* (the Common House Crow); 35 of *Ploceus philippinus* (the Baya or the Common Weaverbird); 14 of *Acridotheres tristis* (the Common Myna); 4 of *Passer domesticus* (House Sparrow); 4 of *Hirundo concolor* (the Dusky Crag Martin) and one of *Copsychus saularis* (the Magpie Robin). The studies were carried out mainly between May and November 1953 and were supplemented by a few observations in 1954. The nests were collected in and around Poona City and brought to the laboratory in bags or sheets of plastic cloth well sealed to prevent the escape of arthropods. Data recorded for each nest included the date, the name of the tree, or a description of the location, the number of eggs or fledglings found and their approximate age. On a few occasions more than one nest located on the same tree have been handled as one nest.

On arrival at the laboratory the nests were pulled apart and processed the same day in Berlese funnels which were specially designed for the purpose. The funnels were made of bright new tinplate and had an upper

diameter of 18 inches and a length of 24 inches. They tapered down to a diameter of one inch at the bottom which had a stem 2 inches long and one inch in diameter. A grid made of 1/4 inch galvanised wire netting was fitted inside the funnel at its middle height. Over the funnel was a 150 watt electric bulb with a polished conical reflector made of tinplate. Three such funnels were mounted on a wooden stand. Conical glass flasks of one litre capacity were sealed with adhesive tape and paraffin to the stems of the funnels to receive the arthropods which would crawl away from the nests when the light was turned on. The apparatus was kept functioning for 24 hours but the first collecting flask was replaced by a new one at the end of the first two hours. It was the general experience that the vast majority of the arthropods collected by this method were found in the flasks within the first two hours. The arthropods were chloroformed and examined immediately after the removal of the flasks from the funnels. All the blood sucking arthropods were immediately separated, identified and those which could be used for virological studies were made into pools for inoculation into mice. Adequate samples were however retained for further identifications. The remaining material was preserved either in spirit or mounted on slides as found necessary.

No special descriptions of the nests are necessary as they were typical of the nests of the birds studied. Regarding the location of the nests 13 crow nests were on Banyan trees, 18 on Tamarind trees and 10 on Neem trees and the rest on five other kinds of trees. Sixteen weaverbird nests were on Babul trees and five on Toddy palms. Twelve myna nests were in holes in stone road bridges or in stone walls and two in holes in trees. All the sparrow nests were in holes in a stone bridge.

Of the 56 nests of crows, eight were deserted, 15 had one to five eggs, two had an egg and two fledglings each and the remaining had one to four fledglings. Among the 35 weaverbird nests, 12 were deserted, eight had one to four eggs and the remaining one to four fledglings each. One myna nest was deserted and 13 had one to three fledglings each. Two sparrow nests had three fledglings each and one had three eggs each and one had three eggs and one fledgling.

All the weaverbird nests examined contained one or more small lumps of clay inside. This is a well known feature but there was no evidence of any larvae of beetles being stuck into them. It may be recalled that there is popular belief among some naturalists that the Baya uses the mud for sticking light producing larvae of beetles.

RESULTS

The data collected are summarised in Tables 1, 2 and 3. Table-1 provides information on the number of nests of each kind of bird

examined and the months during which they were examined. Table 2 provides information on the blood sucking arthropods collected and Table 3 gives the data on all arthropod groups collected and the number of times they were found.

TABLE 1
NUMBER OF BIRD NESTS EXAMINED, POONA

Month	<i>Corvus splendens</i>	<i>Ploceus philippinus</i>	<i>Acridotheres tristis</i>	<i>Passer domesticus</i>	<i>Hirundo concolor</i>	<i>Copsychus saularis</i>
1953						
May	..	..	..	..	..	..
June	28	..	2	..	..	..
July	25	..	5	..	..	..
August	..	..	6	3	1	..
September	..	13	1	..	3	..
October	..	15	..	..	..	..
November	..	2	..	..	..	1
1954						
February	..	..	..	1	..	..
April	3	..	..	..	..	..
November	..	5	..	..	..	..
Total	56	35	14	4	4	1

From the point of view of sheer numbers mites, particularly parasitic mesostigmatid mites, were the predominating group of arthropods in the nests of all birds except the House sparrow. From the point of view of frequency of occurrence Coleoptera and Diptera share the pride of place. Whether numerical abundance or frequency of occurrence should be used as the criterion for determining the dominance of any group is generally a moot question but for the purpose of this study it seems best to grade the groups according to both. The order of abundance of the major groups may be represented as follows :

Nests of House Crow		Nests of Weaverbird		Nests of Myna	
Numbers	Frequency	Numbers	Frequency	Numbers	Frequency
Mites	Diptera	Mites	Coleoptera	Mites	Coleoptera
Diptera	Coleoptera	Psocoptera	Hemiptera	Coleoptera	Mites
Coleoptera	Mites	Hemiptera	Mites	Diptera	Diptera

Hymenoptera Psocoptera Diptera Psocoptera
 Psocoptera Hemip- Hymenop- Hymenoptera
 tera tera
 Collembola Lepidoptera
 Lepidoptera Collembola

TABLE 2

BLOOD SUCKING ARTHROPODS COLLECTED IN NESTS OF THREE SPECIES OF BIRDS

Nests of	<i>Corvus splendens</i>	<i>Ploceus philippinus</i>	<i>Acridotheres tristis</i>
Total number of nests examined	56	35	14
DIPTERA			
<i>Culicoides</i> spp.			
No. of times found	34	11	2
Total found	198	88	3
Maximum No. found in any nest..	47	21	2
<i>Sergentomyia</i> sp.			
No. of times found	4	..	..
Total found	4	..	..
Maximum No. found in any nest..	1	..	..
HEMIPTERA			
<i>Anthocoridae</i>			
No. of times found	14	25	..
Total found	73	281	..
Maximum No. found in any nest..	18	51	..
ACARINES			
<i>Ornithonyssus bursa</i>			
No. of times found	19	1	6
Total found	13,742+	1	709+
Maximum No. found in any nest..	10,000+	1	400+
<i>Pellonyssus</i> sp.			
No. of times found	13	29	5
Total found	2172+	15,876+	464+
Maximum No. found in any nest..	1500+	10,000+	200+
<i>Laelaptidae</i>			
No. of times found .. ..	..	2	2
Total found .. ..	..	300+	10
Maximum No. found in any nest..	..	200+	9
TICKS			
<i>Haemaphysalis</i> sp.			
.. ..	..	1	..
<i>Argas</i> sp.			
.. ..	1	..	..

In the nests of House sparrows the most abundant group was Collembola followed closely by mites.

TABLE 3

ARTHROPODS COLLECTED FROM BIRD NESTS

	<i>Corvus splendens</i>	<i>Ploceus philippinus</i>	<i>Passer domesticus</i>	<i>Acridotheres tristis</i>	<i>Hirundo concolor</i>	<i>Copsychus saularis</i>	Total number of arthropods
Number of nests	56	35	4	14	4	1	112
Insecta							
Thysanura ..	9/16	..	..	1/4	..	..	16
Collembola ..	15/87	..	2/1001	..	..	..	1092
Orthoptera (Cockroaches) ..	4/4	..	3/136	..	..	..	140
Dermoptera ..	2/2	..	..	1/8	..	..	10
Embiopoda ..	2/3	..	..	..	..	1/1	4
Isoptera (Termites) ..	1/2	..	..	..	..	..	2
Psocoptera (Psocids) ..	33/175	25/632	..	2/4	..	..	811
Anoplura ..	..	..	..	1/1	..	..	1
Hemiptera :							
Anthocoridae (Two spp.) ..	14/73	25/281	..	..	..	..	354
Others ..	16/36	6/99	..	..	..	..	135
Lepidoptera :							
Adults ..	4/4	..	..	..	..	..	4
Larvae ..	10/51	1/2	..	..	..	..	53
Trichoptera :							
Larvae ..	1/2	..	..	..	..	..	2
Diptera :							
Larvae ..	13/57	1/1	1/4	3/24	..	..	86
Psychodinae ..	22/65	..	..	2/7	..	..	72
Phlebotominae ..	4/4	..	..	..	..	..	4
Culicoides sp. ..	34/198	11/88	..	2/3	..	..	289
Chloropidae ..	14/180	..	..	..	..	..	180

Note : No. of nests positive No. of specimens.

	<i>Corvus splendens</i>	<i>Ploceus philippinus</i>	<i>Passer domesticus</i>	<i>Acridotheres tristis</i>	<i>Hirundo concolor</i>	<i>Copsychus saularis</i>	Total number of arthropods
Others	..	..	..	..	..	..	61
Hymenoptera (ants)	16/ 51	3/ 6	.. 2	3/ 4	..	..	330
Coleoptera—Adults	.. 17/ 206	20/ 120	1/ 2	1/ 2	.. 1/3	..	461
Larvae	.. 44/ 191	31/ 143	2/ 16	10/108	..	..	509
	.. 27/ 250	5/ 8	1/ 11	13/240	..	..
Arachnida							
Spiders	.. 16/ 36	2/ 5	..	1/ 35	..	..	76
Scorpions	.. 1/ 1	..	..	..	..	..	1
Pseudoscorpions	.. 4/ 5	..	1/ 4	2/ 2	..	..	11
Ticks	..	..	..	..	..	..	1
<i>Haemaphysalis</i> sp.	.. 1/ 1	1/ 1	..	..	..	..	1
<i>Argas</i> sp.	..	..	..	..	..	..	1
Mites							
Dermatonyssidae: <i>Ornithonyssus bursa</i>	.. 19/13,742+	1/ 1	..	6/709	..	..	14,452+
<i>Pellonyssus</i> sp.	.. 13/1172	29/15,876	..	5/464	..	..	18,512+
Fedrizidae	.. 2/ 4	..	..	1/ 20	..	..	20
Trombidiformis: Smaridiidae	.. 2/ 2	..	..	..	..	..	4
Cheyletidae	.. 5/ 8	..	..	..	..	..	2
Others	.. 1/ 1	..	..	..	..	..	8
Hydrachnellae	..	..	..	..	..	..	1
Sarcoptiformis:							
Epidermoptidae	.. 1/ 100	1/ 2	..	..	..	..	2
Tyroglyphidae	..	..	..	..	..	..	100
Others	..	..	..	..	.. 1/1	..	1
Uropodina	..	..	3/ 35	1/ 5	..	..	40
Oribatei	.. 5/ 51	..	2/218	3/827	..	..	1096
Laelapidae	..	..	..	2/ 10	..	..	310
Undetermined mites	.. 3/ 73	2/ 300	..	..	..	..	73
Myriapoda							
Centipedes	..	..	1/ 3	..	..	..	3
Millipedes	..	..	1/ 1	..	..	..	1

The blood sucking forms will be first considered in detail followed by a general review of the fauna. The blood sucking arthropods found were :—

Mites	Dermanyssidae	<i>Ornithonyssus bursa</i> (Berlese), <i>Pellonyssus</i> sp. n.
	Laelaptidae	<i>Laelaps</i> spp. Two species.
Ticks	Ixodidae	<i>Haemaphysalis</i> sp. (once only).
	Argasidae	<i>Argas</i> sp. (once only).
Diptera	Psychodidae	<i>Seigentomyia punjabensis</i> (= <i>Phlebotomus antennatus</i> Sinton).
	Ceratopogonidae	<i>Culicoides oxystoma</i> .
		<i>C. guttifer</i> .
		<i>Culicoides (Trithecoides) flaviscutatus</i> . Wirth & Hubert 1959 (formerly included under the <i>Culicoides anophelis</i> group on the basis of the presence of 3 spermathecae, and subsequently the group has been studied and a new species established).
		<i>Culicoides</i> sp. undet.
Anoplura		Genus and species indet (once only).
Hemiptera : (Provisionally included)	Anthocoridae	<i>Blaptostethus piceus</i> Aabr. and <i>Cardiastethus</i> sp.

Ornithonyssus bursa (formerly known as *Bdellonyssus bursa*) is the well known tropical fowl mite having a wide distribution in the tropics of both eastern and western hemispheres. In and around Poona it occurs in good numbers in coops of domestic chicken. Fonseca (1948), in his monograph on Macronyssidae (now family Dermanyssidae) lists *Gallus domesticus*, *Columba livia domestica*, *Passer domesticus domesticus* 'Hibou' a bird, and *Homo* as the recorded hosts of which *Gallus* and *Homo* are recorded as hosts in India. Strandmann & Wharton (1958) add the bandicoot and 'hen, turkeys, wild birds and wood thrush' to the host list. The present study therefore adds *Corvus splendens* and *Acridotheres tristis* to the host list for the species. Apart from the finding of these mites in the nests they have been collected directly off the bodies of the birds themselves.

It is interesting that while 19 out of 56 crow nests and six out of 14 myna nests harboured *O. bursa*, except for one solitary specimen this

mite was not found in any of the 35 weaverbird nests examined. Even the solitary specimen might have been accidentally introduced. This is remarkable considering the findings that this species is very widely distributed in and around Poona and that weaverbird nests harbour large numbers of another mite of the same family. The largest number found in any nest was conservatively estimated as 10,000+ in a crow nest examined on June 29, 1953. Usually all the developmental stages were found in the nests and a good proportion of adults and protonymphs had taken fresh blood meals.

The species of *Pellonyssus* (formerly included under *Steatonyssus*)¹ found in the nests seem to be a new one and is being recorded here for the first time. It is being separately described². Only four species of '*Steatonyssus*' (as understood earlier) had hitherto been recorded from India, viz. *Pellonyssus viator* Hirst (= *Steatonyssus viator*) from *Cypselus* (= *Micropus*) *affinis*, the Indian Swift, from Calcutta; *Steatonyssus javensis* (Oudemans) from an unknown host, probably a bat, from Khandala some 45 miles NW of Poona City; *Steatonyssus hubli* Hiregaudar & Bal, from a bat, *Pipistrellus ceylonensis*, in the Deccan, and *Steatonyssus musculi*, from a mammal (probably a bat) in Bombay (Strandtmann & Wharton 1958). The present records of *Corvus splendens*, *Acridotheres tristis* and *Ploceus philippinus* as hosts are new for the genus *Pellonyssus*. It is significant to note that for a common species, *Pellonyssus* has not been taken at any time in the coops of domestic chicken.

Pellonyssus sp. was found in 13 crow nests, 29 weaverbird nests and five myna nests. On two occasions it was associated with *O. bursa* in crow nests and on four occasions in myna nests. It was the sole representative (except for the solitary specimen of *O. bursa* mentioned above) of Dermanyssidae in weaverbird nests. The maximum number found in any nest was approximately 10,000+ in a weaverbird nest examined on October 8, 1953. This species was comparatively more numerous than *O. bursa* wherever it occurred. All developmental stages were usually found and a good proportion of adults and protonymphs were found to have taken fresh blood meals.

Laelaptidae are characteristically parasites of mammals and their occurrence in the nests of birds calls for special comment. There was not a single specimen of this family in the nests of crows. They were found in only two weaverbird nests collected on the same day and in two

¹ The genus *Pellonyssus* was erected in 1956 (Claude & Yunker 1956) separating it from *Steatonyssus* on the basis of differences in the shape of the female sternal plate and the male chela. *Pellonyssus* are primarily ectoparasites of birds, and *Steatonyssus* of mammals, particularly chiropterans.

² Proposed to be named *P. deccanus* Rao. Thanks are due to Dr. F. Da Fonseca of Instituto Butantan, Sao Paulo, Brazil, for pointing out that this is a new species.

myna nests. A few deserted weaverbird nests were collected on November 5, 1954, long after the nesting season for the bird. B. S. Lamba who collected the nests immediately noticed that one of them contained a few young mice. The nest was brought to the laboratory and when examined was found to contain inside a secondary nest of field mice. Nine live young mice with a large number of mites crawling on their bodies were taken out. The nest itself yielded about 200 mites all of most probably *Laelaps* sp. Another nest collected later in the day by one of the authors (TRR) also contained a secondary mouse nest and though there were no live mice in it, yielded about 100 laelaptid mites. The single myna nest from which nine laelaptids were collected was located in a hole in a stone bridge, and had two fledglings. In all the three cases the mites showed evidence of having taken blood meals. While in the case of weaverbird nests one may infer that the mites had fed on mice there was no evidence for a similar opinion in the case of the myna nest. But the location of the myna nests was such that mice might have normally frequented them and it may be that the laelaptid mites there had been introduced by the visiting mice. The specific identifications of the laelaptids have not yet been made. Two species seem to be present.

Among ticks only one engorged specimen of a nymph of *Haemaphysalis* sp. was found in the nest of a weaverbird and one *Argas* sp. in the nest of a crow. Several *Haemaphysalis* species have been collected on birds in and around Poona by us and therefore the finding of only one specimen in the nest is surprising. The specimen has not been well preserved and specific identification is not possible. *Argas* spp. are not quite common round about Poona though they have been occasionally collected in chicken houses. Several unsuccessful special searches for Argasidae were made in the holes and crevices and under bark of trees on which birds roost at night. The scarcity of Argasidae in the nests is therefore not unexpected.

The Phlebotominae found consisted of only four specimens, two males and two females, one each in four crow nests. All belong to the recumbent haired group of sandflies and the males have been identified as *Sergentomya puujabensis* (formerly known as *P. antennatus*). Large numbers of sandflies have sometimes been collected in the hollows and crevices of trees in and around Poona, and their occurrence in the nests may be accidental.

Culicoides spp.¹ were the sole representatives in the nests of blood sucking Diptera. Twenty-seven males and 171 females were found in

¹ The authors are grateful to Dr. R. A. O. Smith at that time of the All India Institute of Hygiene, Calcutta, for examining representative slides and confirming the identifications of *Culicoides*. He was of the opinion that the single specimen of the fourth species found in a crow nest may be a new species. It has perfectly clear wings and is unlike the only other species with clear wings described from India, *C. albipinnes* (now known as *C. kamrupi*).

34 crow nests, 27 males and 61 females in 11 weaverbird nests and no males and three females in two myna nests. The species found were :

- | | |
|-------------------------|--|
| <i>C. oxystoma</i> | in 17 crow nests and two myna nests. |
| <i>C. guttifer</i> | in 16 crow nests and seven weaverbird nests. |
| <i>C. flaviscutatus</i> | in one crow nest [formerly included under <i>C. anophelis</i> because of the presence of three spermathecae. Subsequently this group has been studied and several species with three spermathecae have been discovered. Sen & Dasgupta (1959) have recorded 33 species of <i>Culicoides</i> in India]. |

Culicoides sp. indet.

It is noteworthy that *C. oxystoma* did not occur in weaverbird nests at all. In crow nests *C. oxystoma* and *C. guttifer* were found together on eight occasions. Many of the females had taken fresh blood meals and though the suspicion is strong it cannot be stated that all of them had fed on the birds in the nests.

Anthocoridae formed the majority of Hemiptera collected in the nests. They are a cosmopolitan group of bugs some of which are well known to occur in bird's nests. The two forms found in the present studies were *Blaptostethes piceus* and *Cardiastethes* sp.¹ They were found in 14 crow nests, 25 weaverbird nests. All developmental stages were found and the maximum number found was 83 in a weaverbird nest. In general appearance they were bright pinkish in colour and many of them had a bright pink fluid in their abdomen. Whether it was blood or whether the colour of the fluid was merely a secondary effect of the general coloration of the body cannot be stated. The members of this family are mainly predators on mites but at least one species, the cosmopolitan *Lytocoris compestris* is definitely known to bite human beings and 'suck' blood (Imms 1951 ; Rothschild & Clay 1952 ; and Woodroffe 1953). Therefore the *Anthocoridae* are for the present provisionally included in the blood sucking arthropods.

A solitary specimen of Anoplura was found in the nest of a myna which has not yet been identified. As sucking lice are rarely, if ever, found on birds its presence in the nest may be accidental.

¹ The identification of the two species of *Anthocoridae* has been kindly made by Dr. W. E. China of the British Museum. He says that *Blaptostethes piceus* var *palescens* has been recorded from Bombay and that *Cardiastethes* sp. may be a new species or a small race of the European species, the Palearctic *C. fasciventris* (Garbl). The authors are most grateful to Dr. China for these comments.

Arthropods other than the blood sucking forms have not been studied in detail and only brief notes regarding each group will be given below.

The *non-parasitic mites* found were :—

- Mesostigmata .. Uropodina ; once in myna nest and thrice in sparrow nest. They were quite abundant on a couple of occasions.
Fedrizzina ; once in myna nest.
Others ; thrice in crow nests.
- Trombidiformes .. Cheyletidae ; twice in crow nests.
Smaridiidae ; thrice in crow nests.
Others ; five times in crow nests.
- Sarcoptiformes .. Tyroglyphidae ; once in crow nest.
Oribatei ; five times in crow nests, thrice in myna nests and twice in sparrow nests.
- Hydrachnellae .. Once in crow nest.
- Others .. Once in weaverbird nest.

Generic identifications have not been made. Some are predators and some scavengers attracted to the nests by the other fauna. Uropodina and Oribatei were the only two groups found in any appreciable numbers.

Collembola : None was found in the weaverbird nests but some numbers commonly found in other nests. In one sparrow nest over a thousand were collected.

Thysanura : They were rare and *Lepisma* sp. was the only form.

Orthoptera : They were rare but over hundred were collected from a sparrow nest. They were almost entirely members of the Blattidae.

Dermaptera : Forficulidae were found on two occasions in crow nests and once in myna nest.

Psocoptera : They were abundantly found in crow and weaverbird nests.

Hemiptera : Apart from the *Anthocoridae* already referred to the only other family found was Pentatomidae, in 16 crow nests and six weaverbird nests.

Embioptera : They were rare having been found only twice in crow nests and in a magpie-robin nest.

Lepidoptera : Adults of Microlepidoptera were found on four occasions in crow nests. Larvae of Lepidoptera were common.

Coleoptera : They were rich both in number and variety. Both adults and larvae were frequently found. No identifications of adults have been made but among the larvae commonly found were Chrysomelidae, Dermestidae, Coccinellidae and Buprestidae.

Diptera : They were quite abundant in crow nests. The majority of the adults of Diptera other than *Culicoides* were members of Psychodidae and Chloropidae. Psychodinae occurred in 22 crow nests and two myna nests. Chloropidae ('Eye-flies') were found in 14 crow nests. Neither of these families was represented in weaverbird nests. The larvae found mainly consisted of Muscidae, Calliphoridae and a few Psychodidae.

Hymenoptera : They consisted mainly of ants.

Myriapoda : Only three centipedes and one millipede were found in sparrow nests.

Arachnids other than mites and ticks : They were comparatively rare. Pseudoscorpions occurred only in four crow nests, two myna nests and one sparrow nest. Spiders were found twice in weaverbird nests and 16 times in crow nests. One crow nest had a scorpion.

DISCUSSION

The primary objective of this study was the determination of the blood sucking arthropods associated with the common birds in their nests in and around Poona. It was established that two species of dermanyssid mites, viz. *Ornithonyssus bursa* and *Pellonyssus* sp., and two species of *Culicoides*, viz. *C. oxystoma* and *C. guttifer* are very frequently associated with the birds studied. The other blood sucking arthropods except the anthocorid bugs which are provisionally included among them, were too few to merit comment.

While both the species of mites and both the species of midges mentioned above were found in the nests of House crows and mynas, *O. bursa* and *C. oxystoma* were not found in the nests of weaverbirds. This may either be due to a real difference in the host parasite relationship or to causes connected with the environment and habits of the birds. Furthermore extensive studies would be needed to answer this question.

The occurrence of mites in the nests was expected but the frequent presence of *Culicoides* was somewhat of a surprise. They cannot be regarded as accidental visitors for they were present in 47 of the 112 nests

examined. The presence of both males and females leads one to the question whether their occurrence in the nests was merely due to the facilities offered by the nest material for breeding or to a direct attraction exerted by the birds. So little is known of the biology of this group of midges in India that one hesitates to dwell on this question at any length. Mention may be made in this connection of the suspected role they play in the transmission of the virus of Blue tongue of sheep and African horse sickness both of which have occurred in India.

The anthocorid bugs were found in 39 nests. This group has received practically no attention from medical entomologists considering the fact that at least one member of the family is known to suck blood and that they are frequently found in the nests of birds. It would be worthwhile to study their habits in greater detail and explore the possibility of their being connected with the dissemination of disease producing organisms.

Notable for their complete absence in the nests studied were members of Siphonaptera (fleas), Cimicidae ('bed-bugs') and Hippoboscidae (louseflies) all of which have been reported frequently as occurring in the nest in other countries. Fleas are apparently not common parasites of birds in and around Poona as no flea has been collected on any of a good number of wild birds examined (VRC unpublished data), though *Echidnophaga gallinacea* has sometimes been found in chicken houses.

Cimicidae are known to occur in the nests of some birds in India. Reference may be made to the interesting observation by Abdulali (1942) on the occurrence of *Cimex rotundatus* in the nests of swifts and terns in the Vengurla Rocks off the southernmost coast of Bombay State.

Hippoboscid flies were quite frequently found by the authors on the bodies of crows and mynas in and around Poona and their total absence in the nests is noteworthy. These flies have the habit of leaving the body of the host within a matter of seconds after the bird is knocked down by gun shot and very quick action was usually necessary on the part of the collector to put the knocked down bird into the collecting bag in order to secure the flies. But in the case of nests there is no possibility of such a quick escape of the flies as the nests were collected and secured in the collecting bag intact. Therefore the complete absence of hippoboscid flies in the nests would indicate that the flies do not parasitize the fledglings as readily as they do the adult birds. As no pupae of the louseflies were also found in the nests perhaps the birds become infested elsewhere.

The total absence of Mallophaga and feather mites in the nests also calls for comment. All the species of birds examined in and around Poona have been infested by Mallophaga and several families of feather mites. Sometimes the infestation is quite heavy particularly in the case of the crows. It is well known that these groups of parasites rarely

leave the bodies of the hosts but one would have expected that a few of them would stay away from the birds and be found in the nest material.

An ecologist would like further to analyse the arthropod fauna of nests either quantitatively to determine the constancy of occurrence and dominance of any group and 'fidelity of association between the several groups of nidicoles' or qualitatively to classify them as ectoparasites of birds, scavengers, predators and parasites, accidental visitors and so on. Interesting and profitable as such studies are, the data collected in the present investigation are not detailed enough for the purpose.

The studies were all made on nests collected during daytime. There is no doubt that the nests are visited by several types of arthropods at night notably by mosquitoes and sandflies. Strictly speaking they should also be included in the lists of arthropods found in the nests, but classified as visitors rather than as regular members of the fauna.

Several pools made from mites and *Culicoides* found in the nests were inoculated into mice but no pathogenic virus was isolated. Much significance need not be attached to this negative finding as it is well known that a virus isolation in nature would require an enormous amount of effort at the appropriate time. Neither *O. bursa* nor any species of *Pellonyssus* has yet been definitely incriminated anywhere as a vector of any virus disease though the former has long been suspected in view of its close association with domestic poultry. None of the pools of *Culicoides* processed have yielded any virus though their role in the epidemiology of some virus diseases (Blue tongue, African horse sickness) is known. Because of their association with birds they deserve more attention than they have received hitherto.

Mention may, however, be made here of the isolation of Sindbis virus, from a pool of *Ornithonyssus bursa* collected from domestic chicken in a place in Kanara District (formerly in Bombay State and from November 1956 in Mysore State) (Shah *et al.* 1960). The mere isolation from arthropods does not, however, confirm its status as a vector.

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